What is claimed is:

1. A process for the partial oxidation of at least one hydrocarbon comprising the steps of:

(a) contacting an oxygen ion conducting ceramic in particulate form in a reactor with an oxygen-containing gas at a temperature in the range between about 300 and 1400°C and at a pressure in the range between about 1 and 50 bara, wherein oxygen from said oxygen-containing gas is reacted with said ceramic, thereby producing an oxygen-enriched ceramic; and

(b) contacting said oxygen-enriched ceramic in said reactor with a hydrocarbon at a temperature in the range between about 300 and 1400°C, thereby producing a product gas through the reaction between said oxygen-enriched ceramic and said hydrocarbon.

2. The process of claim 1, wherein step (b) is conducted at a pressure of between about 1 and 50 bara.

3. The process of claim 1, wherein said product gas is a gas comprising hydrogen and carbon monoxide.

4. The process of claim 1, wherein said oxygen ion conducting ceramic is selected from the group consisting of: (1) perovskite substances having the structural formula ABO_3, where A is at least one metal ion capable of occupying the 12-coordinate sites of the perovskite and B is at least one metal ion capable of occupying the 6-coordinate sites of the perovskite; (2) ceramic substances selected from the group consisting of Bi_2O_3, ZrO_2, CeO_2, ThO_2, HfO_2 and mixtures thereof, the ceramic substance being doped with CaO, rare earth metal oxides or mixtures thereof; (3) brownmillerite oxide; and (4) mixtures thereof.

5. The process of claim 4, wherein said oxygen ion conducting ceramic is a perovskite substance having the structural formula ABO_3.

6. The process of claim 5, where A is at least one metal ion selected from alkali, alkaline earth and rare earth ions, and B is at least one metal atom selected from transition metal ions.

7. The process of claim 6, where A is La, Sr, Ca, Ba, Mg, or mixtures thereof, and B is Co, Mn, Cr, Ni, Fe, or mixtures thereof.

8. The process of claim 1, wherein said oxygen-containing gas is air.

9. The process of claim 1, wherein step (a) is carried out at a temperature between about 600 and 1000°C and a pressure between about 1 and 2 bara.

10. The process of claim 1, wherein step (b) is carried out at a temperature between about 600 and 1000°C.

11. The process of claim 2, wherein step (b) is conducted at a pressure between about 3 and 35 bara.

12. The process of claim 1, further comprising the step of purging said product gas from said reactor following step (b) with a gas selected from the group consisting of: steam, carbon dioxide, nitrogen, argon, helium, and mixtures thereof.

13. The process of claim 1, wherein said at least one hydrocarbon is selected from the group consisting of: aliphatic hydrocarbons, cycloaliphatic

hydrocarbons, aromatic hydrocarbons, and mixtures thereof, provided that said hydrocarbon has a carbon number in the range between about 1 and 12.

14. The process of claim 13, wherein said at least one hydrocarbon is selected from the group consisting of: methane, methanol, natural gas, naphtha, gasoline, diesel, and mixtures thereof.

15. The process of claim 1, further comprising at least one particulate material other than said ceramic in said reactor.

16. The process of claim 15, wherein said particulate material has a heat capacity greater than that of said ceramic.

17. The process of claim 16, wherein said particulate material is placed upstream, downstream or both upstream and downstream of said ceramic.

18. The process of claim 16, wherein said particulate material is mixed with said ceramic.

19. The process of claim 18, wherein said ceramic is supported on said particulate material.

20. The process of claim 1, further comprising a step of contacting said ceramic with a moderating agent during step (b).

21. The process of claim 20, wherein said moderating agent is selected from the group consisting of steam, carbon dioxide and mixtures thereof.

22. The process of claim 1, further comprising repeatedly performing steps (a) and (b) in sequence, or (b) and (a) in sequence.

23. A continuous process for the partial oxidation of at least one hydrocarbon comprising the steps of:

(a) in a first reactor, contacting a first oxygen ion conducting ceramic with an oxygen-containing gas at a temperature in the range between about 300 and 1400°C and at a pressure in the range between about 1 and 50 bara, wherein oxygen from said oxygen-containing gas reacts with said first ceramic, thereby producing a first oxygen-enriched ceramic; and contacting said first oxygen-enriched ceramic with said hydrocarbon at a temperature in the range between about 300 and 1400°C, thereby producing a first product gas; and

(b) in a second reactor, contacting a second oxygen ion conducting ceramic with an oxygen-containing gas at a temperature in the range between about 300 and 1400°C and at a pressure in the range between about 1 and 50 bara, wherein oxygen from said oxygen-containing gas reacts with said second ceramic, thereby producing a second oxygen-enriched ceramic; and contacting said second oxygen-enriched ceramic with said hydrocarbon at a temperature in the range between about 300 and 1400°C, thereby producing a second product gas.

24. The process according to claim 23, wherein said first reactor is 180° out of phase with said second reactor, whereby either:

(a) said first product gas is being formed in and removed from said first reactor while oxygen from an oxygen-containing gas is reacting with said second ceramic in said second reactor; or

(b) oxygen from an oxygen-containing gas is reacting with said first ceramic in said first reactor while said second product gas is being formed in and removed from said second reactor.

25. The process according to claim 23 wherein three or more reactors are used in said process.

26. A system for the continuous production of a product gas from the partial oxidation of at least one hydrocarbon, said system comprising:

(a) a first reactor comprising a first oxygen ion conducting ceramic;

(b) means for contacting said first oxygen ion conducting ceramic with an oxygen-containing gas at a temperature in the range between about 300 and 1400°C and at a pressure in the range between about 1 and 50 bara, wherein oxygen from said oxygen-containing gas reacts with said first ceramic, thereby producing a first oxygen-enriched ceramic;

(c) means for contacting said first oxygen-enriched ceramic with said hydrocarbon at a temperature in the range between about 300 and 1400°C, thereby producing a first product gas;

(d) a second reactor comprising a second oxygen ion conducting ceramic;

(e) means for contacting said second oxygen ion conducting ceramic with an oxygen-containing gas at a temperature in the range between about 300 and 1400°C and at a pressure in the range between about 1 and 50 bara, wherein oxygen from said oxygen-containing gas reacts with said second ceramic, thereby producing a second oxygen-enriched ceramic; and

(f) means for contacting said second oxygen-enriched ceramic with said hydrocarbon at a temperature in the range between about 300 and 1400°C, thereby producing a second product gas.

27. The system according to claim 26, further comprising a first means for removing said first product gas from said first reactor and a second means for removing said second product gas from said second reactor, wherein said first and second removing means can be either different or the same.

28. The system of claim 26, wherein steps (c) and (f) are conducted at a pressure between about 1 and 50 bara.

29. The system of claim 26, wherein said oxygen ion conducting ceramic is selected from the group consisting of: (1) perovskite substances having the structural formula ABO_3, where A is at least one metal ion capable of occupying the 12-coordinate sites of the perovskite and B is at least one metal ion capable of occupying the 6-coordinate sites of the perovskite; (2) ceramic substances selected from the group consisting of Bi_2O_3, ZrO_2, CeO_2, ThO_2, HfO_2 and mixtures of these, the ceramic substance being doped with CaO, rare earth metal oxides or mixtures of these; (3) brownmillerite oxide; and (4) mixtures thereof.

30. The system of claim 29, wherein said oxygen ion conducting ceramic is a perovskite substance.

31. The system of claim 26, wherein said oxygen-containing gas is air.

32. The system of claim 26, further comprising at least one means for heating said oxygen-containing gas, said hydrocarbon gas, and combinations thereof.

33. The system of claim 32, wherein said means is at least one heat exchanger.

34. A process for the production of cyclic anhydrides via partial oxidation of at least one hydrocarbon comprising the steps of:

(a) contacting an oxygen ion conducting ceramic having an anhydride-forming catalyst disposed thereon with an oxygen-containing gas at a temperature in the range between about 250 and 650°C and at a pressure in the range between about 1 and 50 bara, wherein oxygen from said oxygen-containing gas reacts with said ceramic, thereby producing an oxygen-enriched ceramic; and

(b) contacting said oxygen-enriched ceramic with hydrocarbon at a temperature in the range between about 250 and 650°C, thereby producing cyclic anhydrides.

35. The process of claim 34, wherein said anhydride-forming catalyst is a vanadium-based catalyst.

36. A process for the production of alkylene oxides via partial oxidation of at least one hydrocarbon comprising the steps of:

(a) contacting an oxygen ion conducting ceramic having an alkylene-forming catalyst disposed thereon with an oxygen-containing gas at a temperature in the range between about 250 and 650°C and at a pressure in the range between about 1 and 50 bara, wherein oxygen from said oxygen-containing gas reacts with said ceramic, thereby producing an oxygen-enriched ceramic; and

(b) contacting said oxygen-enriched ceramic with hydrocarbon at a temperature in the range between about 250 and 650°C, thereby producing alkylene oxides.

37. The process of claim 36, wherein said alkylene-forming catalyst is a silver oxide catalyst.

38. A process for the production of a chlorinated hydrocarbon via partial oxidation of at least one hydrocarbon comprising the steps of:

(a) contacting an oxygen ion conducting ceramic having a chlorinated hydrocarbon-forming catalyst disposed thereon with an oxygen-containing gas at a temperature in the range between about 250 and 650°C and at a pressure in the range between about 1 and 50 bara, wherein oxygen from said oxygen-containing gas reacts with said ceramic, thereby producing an oxygen-enriched ceramic; and

(b) contacting said oxygen-enriched ceramic with hydrocarbon at a temperature in the range between about 250 and 650°C, thereby producing chlorinated hydrocarbons.

39. The process of claim 38, wherein said chlorinated hydrocarbon-forming catalyst is a copper chloride catalyst.

40. A process for the production of aldehydes via partial oxidation of at least one hydrocarbon comprising the steps of:

(a) contacting an oxygen ion conducting ceramic having an aldehyde-forming catalyst disposed thereon with an oxygen-containing gas at a temperature in the range between about 250 and 650°C and at a pressure in the range between about 1 and 50 bara, wherein oxygen from said oxygen-

containing gas reacts with said ceramic, thereby producing an oxygen-enriched ceramic; and

(b) contacting said oxygen-enriched ceramic with hydrocarbon at a temperature in the range between about 250 and 650°C, thereby producing aldehydes.

41. The process of claim 40, wherein said aldehyde-forming catalyst is selected from the group consisting of copper chloride, palladium chloride, molybdenum, bismuth, iron, and mixtures thereof.

42. A process for the production of olefinically unsaturated nitriles via partial oxidation of at least one hydrocarbon comprising the steps of:

(a) contacting an oxygen ion conducting ceramic having a nitrile-forming catalyst disposed thereon with an oxygen-containing gas at a temperature in the range between about 250 and 650°C and at a pressure in the range between about 1 and 50 bara, wherein oxygen from said oxygen-containing gas reacts with said ceramic, thereby producing an oxygen-enriched ceramic; and

(b) contacting said oxygen-enriched ceramic with hydrocarbon at a temperature in the range between about 250 and 650°C, thereby producing olefinically unsaturated nitriles.

43. The process of claim 42, wherein said nitrile-forming catalyst is selected from the group consisting of bismuth-molybdenum oxide catalyst and iron-antimony oxide catalyst.